

09-0418A EVA 9: FINAL EVA PROCEDURES

US EVA SUMMARY						
EVA PET	GMT	RS Ground Pass	Day/ Night	GROUND IV	EV1 (Padalka)	EV2 (Fincke)
00:52 --	22:42 --	23:28 -- 23:30* -- 23:51	22:53	Begin DDCU Powerdown <i>Note: CETA lights off</i>	<u>US EVA SETUP</u> (00:38) - Tether Swap at S0	<u>US EVA SETUP</u> (00:38) - Tether Swap at S0
01:30 ---	23:15 --		23:29	Give EV GO for RPCM removal (√inhibits)	<u>S0-2B D RPCM R&R</u> (02:30) - Fluid Umbilical Tray Release	<u>S0-2B D RPCM R&R</u> (02:30) - Release SPDA Door Launch Locks - Fluid Umbilical Tray Release
03:00 ---	00:45 --		00:25		- Open SPDA Door - RPCM R&R	- Open SPDA Door - RPCM R&R
			01:00		- Close SPDA Door and Secure Umbilical	- Close SPDA Door and Secure Umbilical
04:30 ---	02:25 --		01:56	Give MCC GO for RPCM/DDCU Power-Up	<u>US EVA CLEANUP</u> (00:45) - Tether Swap at S0	<u>US EVA CLEANUP</u> (00:45) - Tether Swap at S0
05:15 ---	03:05 --	02:35 02:55	02:32			

* Required arrival time for Crew to arrive @ Outpost;
See page 5 for further details

EVA TOOL CONFIG

EV1 (Gennady)

OTA

- ☐ Waist Tether
- ☐ D-Ring Extender
- ☐ Right Swing Arm
 - ☐ 1 - RET
- ☐ BRT
 - ☐ 1 - RET
 - ☐ 2 - Wire Ties
- ☐ 1 - Adj tether
- ☐ 1 - RET w/ PIP Pin
- ☐ 1 - Wire Tie (Mickey Mouse Ears)

EV2 (Mike)

OTA

- ☐ Waist Tether
- ☐ D-Ring Extender
- ☐ Right Swing Arm
 - ☐ 1 - RET
- ☐ BRT
 - ☐ 1 - RET
 - ☐ 2 - Wire Ties
- ☐ 1 - Adj tether
- ☐ 1 - RET w/ PIP Pin
- ☐ 1 - Wire Tie (Mickey Mouse Ears)

KPU

Bungee Side

- ☐ 4 - Safety Tethers w/ money clips

Pocket Side

In Pocket

- ☐ Russian Tether
 - ☐ Russian Hammer
 - ☐ Russian Scissors
 - ☐ Russian Knife
- ☐ Fish Stringer
 - ☐ Connector Cleaner Tool Caddy
 - ☐ Wire Tie Caddy
 - ☐ Socket Caddy
 - ☐ 7/16 X 12-in socket
- ☐ Spare PGT Battery

Tethered to Pocket Side

- ☐ Medium ORU Bag
 - ☐ RET (attached to Scoop)
 - ☐ Spare RPCM (External)
S/N X800390
 - ☐ Round Scoop (clocked 45° off)
- ☐ 2 - Russian Tie Down Tethers
- ☐ Fish Stringer
 - ☐ EVA Ratchet
 - ☐ 7/16 X 2-in socket
 - ☐ Round Scoop
 - ☐ EVA Camera/Bracket
 - ☐ PGT w/ 7/16 X 9-in socket
S/N _____
 - ☐ PGT w/ 7/16 X 6-in socket
S/N _____
- ☐ RET (for failed RPCM)

KPU (cont.)

For KPU Trasportation

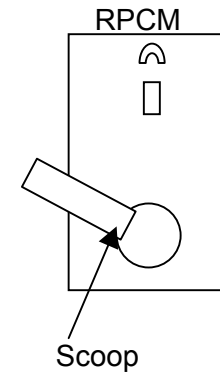
- ☐ 2 - Russian Tethers

To attach ORU Bag to KPU

- ☐ 4 - Adj Tethers
(2 in series across the Bag)
- ☐ Russian Tether
(from Bag HR to KPU)

CAUTION:

Verify GFE covers are removed from RPCM



EVA INHIBIT PAD

MCS

MCC-M

1. √ FGB manifold valves (eighteen) closed
2. √ FGB main engine thruster valves (four) – closed
3. √ FGB MCS unpowered
4. √ SOYUZ manifolds (ten) closed
5. √ SOYUZ MCS unpowered

FGB Antennas

MCC-M

1. √ TORU [TOPY] - Deactivate
2. √ TV System [TBC] - Deactivate
3. √ KURS P [Kurs] - Deactivate
4. √ KURS A [Kurs] - Deactivate
5. √ Sirius - Deactivate

SOYUZ Antennas

MCC-M

1. √ KURS - Deactivate

PCU

NOTE

- MCC-H √ PCUs (two) operational in discharge mode
OR
 √ 1 PCU operational in discharge mode
OR
 √ One solar array oriented at least 105 deg from the
 velocity vector

NOTES, CAUTIONS, AND WARNINGS

NOTES

Verify connectors for debris, bent pins, and cable bend radii

If no comm, go to the Outpost to verify power inhibits complete prior to RPCM removal.

CAUTION

Avoid inadvertent contact with:

- Grapple fixture shafts (have coating)
- Grapple fixture target pin
- SVS Targets
- MBSVDU, MCU, CRPCMs & Cameras
(silver Teflon tape radiative surface)
- Passive UMA
- Deployed TUS cable
- PMA1 MDM sunshade
- EVA crane
- Z1 PCU Cathode Ports
- Z1 heat pipe radiators/coldplates
- SASA – Antenna and Z-93 paint (Z1 & P6)
- KU - Antenna (1 meter)
- S0 Radiators (silver Teflon tape)
- S0 SPDA Radiator
- S0 GPS Antenna (Z-93 paint)
- MT-LTU Radiators
- Lights (Z-93 paint)
- WETA antennas

Fiber Optic Cable Handling:

- Avoid bend radius less than 10 times cable diam
- Avoid pulling on harness during connector mate/demate

PMA handrails may be hot. Handling may need to be limited

For structural reasons:

- Avoid vigorous body motions, quick grabs, and kickoff tether restraints
- Avoid performing shaking motions (sinusoidal functions) more than four cycles

If any of these occur, wait 2-5 min to allow structural response to dissipate.

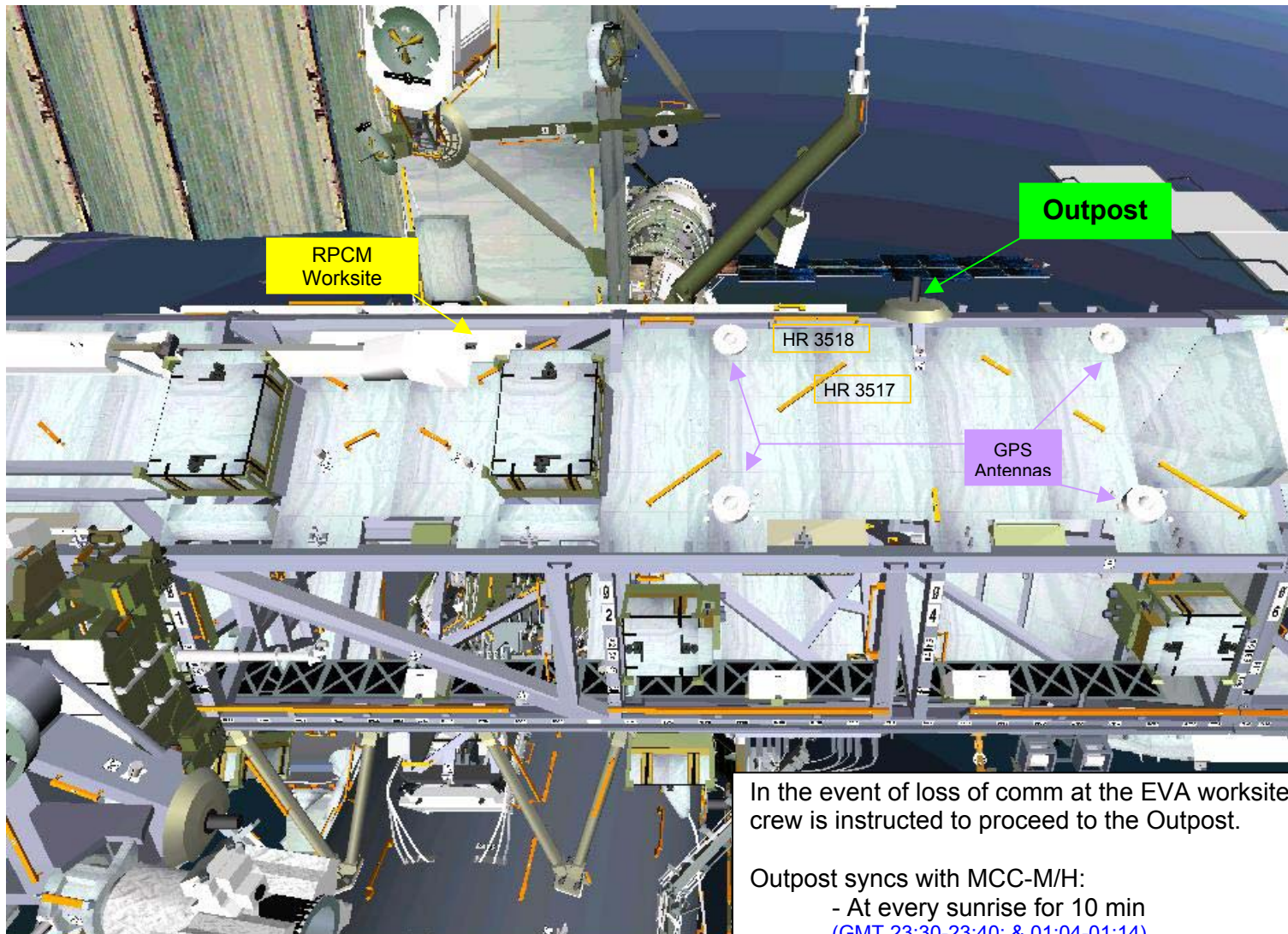
WARNING

PMA umbilical launch restraints have exposed bolt threads (sharp)

EVA connectors present a pinch hazard. Caution should be used when mating/locking connectors

Avoid inner edges of WIF sockets due to potential sharp edges

EVA Outpost Definition and Instructions



In the event of loss of comm at the EVA worksite, the crew is instructed to proceed to the Outpost.

Outpost syncs with MCC-M/H:

- At every sunrise for 10 min
(GMT 23:30-23:40: & 01:04-01:14)
- At every sunset for 5 min
(GMT 00:25-00:30: & 01:55-02:00)
- To confirm power inhibits
- In case of hardware anomalies
- As needed by EV crew

US EVA Setup (00:38)

GROUND IV	EV1 (Gennady)	EV2 (Mike)
	<ol style="list-style-type: none"> 1. Verify safety tether configuration <ul style="list-style-type: none"> ❑ Anchor hook (of safety tether) to PMA1 HR 0003 (PMA1 Zenith, Aft, Stbd) ❑ Money clip inserted ❑ Load alleviating strap of safety tether to D-Ring extender ❑ Waist tether attached between OTA interface block safety tether point and safety tether reel ❑ Orlan fixed length tether stowed on OTA upper tether point 2. Translate to S0 Handrail Bridge for tether swap (S0 HR 3412 recommended) NOTE: EV1 leads translation <p><u>TETHER SWAP AT S0</u></p> <ol style="list-style-type: none"> 3. Attach Bungee tether to structure 4. Retrieve 2 safety tethers from KPU 5. Hand 1 safety tether to EV2 6. Attach anchor hook (of safety tether) to S0 HR 3412 7. Insert Money Clip 8. Transfer waist tether to S0 tether reel 9. Attach load alleviating strap of S0 tether to D-Ring extender 10. Remove PMA1 safety tether; Attach to HR 3413 11. Temp stow KPU on S0 handrail or CETA Cart 12. Remove ORU Bag from KPU 13. Retrieve PGT w/ 6" wobble from ORU Bag, hand to EV2 14. Retrieve PGT w/ 9" from ORU bag, attach to swing arm 15. Translate with ORU Bag on BRT to S0 HR 3430 	<ol style="list-style-type: none"> 1. Verify safety tether configuration <ul style="list-style-type: none"> ❑ Anchor hook (of safety tether) to PMA1 HR 0004 (PMA1 Zenith, Aft) ❑ Money clip inserted ❑ Load alleviating strap of safety tether to D-Ring extender ❑ Waist tether attached between OTA interface block safety tether point and safety tether reel ❑ Orlan fixed length tether stowed on OTA upper tether point 2. Translate to S0 Handrail Bridge for tether swap (S0 HR 3411 recommended) <p><u>TETHER SWAP AT S0</u></p> <ol style="list-style-type: none"> 3. Attach Bungee tether to structure 4. Retrieve safety tether from EV1 5. Attach anchor hook (of safety tether) to S0 HR 3411 6. Insert Money Clip 7. Transfer waist tether to S0 tether reel 8. Attach load alleviating strap of S0 tether to D-Ring extender 9. Remove PMA1 safety tether; Attach to HR 3411 10. Retrieve PGT from EV1, attach to swing arm 11. Translate to S0 HR 3487

EVA RPCM Remove/Replace S0-2B_D (02:30)

GROUND IV	EV1 (Gennady)	EV2 (Mike)
	<p><u>FLUID UMBILICAL TRAY RELEASE</u></p> <ol style="list-style-type: none"> 1. Temp stow ORU bag on HR 3430 2. BRT to HR 3430 or 3433 for Bolt 8 access 3. Open thermal flap covering Bolt 8 4. PGT (B7, 25.5 ft-lb, CCW2 30 RPM) 9-in ext: Release Bolt 8, 9 - 13 turns, until bolt releases 5. Translate to HR 3458; BRT for Bolt 9/10 access 6. PGT (B7, 25.5 ft-lb, CCW2 30 RPM) 9-in ext: Release Bolt 9, 9 - 13 turns, until bolt releases 7. PGT (B7, 25.5 ft-lb, CCW2 30 RPM) 9-in ext: Release Bolt 10, 11.5 - 13.5 turns, until bolt releases NOTE: BRT on opposite end of HR 3458 8. Retrieve ORU Bag from HR 3430 <div data-bbox="667 683 1205 787"> <p>CAUTION</p> <p>Avoid contact to SPDA Radiator (Face 3) to prevent hardware damage</p> </div> <ol style="list-style-type: none"> 9. Translate to RPCM worksite position BRT to Node 3 Tray HR, Head Port/FWD 10. Retrieve tethers from ORU Bag to restrain umbilical 11. Attach hook to Node 3 long HR (Port stanchion); use adjustable end 12. Hand Second hook to EV2 <ol style="list-style-type: none"> 13. Give EV2 GO for Bolt 12 Release <div data-bbox="667 1242 1205 1408"> <p>CAUTION</p> <ol style="list-style-type: none"> 1. Do not pull tray out more than 3-in from Face 2 2. Do not impart loads into beam without minimum of 2 bolts installed </div>	<p><u>RELEASE SPDA DOOR LAUNCH LOCKS</u></p> <ol style="list-style-type: none"> 1. Remove and stow port PIP Pin from door bracket 2. Remove and stow stbd PIP Pin if accessible 3. BRT to HR 3490 4. PGT (B7, 25.5 ft-lb, CCW2 30RPM) 6-in ext: Release SPDA Door Bolts (2), ~ 13 turns ✓ Bolt up, Red sharpie mark visible when released <ol style="list-style-type: none"> 5. If needed, Install Round Scoop on SPDA Door microconical (Scoop is in ORU Bag) 6. Open port SPDA door just past soft dock; ~ 1 - 2-in <p><u>FLUID UMBILICAL TRAY RELEASE</u></p> <ol style="list-style-type: none"> 7. Open thermal flap covering Bolts 11 & 12 BRT to 3490 or 3484 8. PGT (B7, 25.5 ft-lb, CCW2 30 RPM) 6-in ext: Release Bolt 11, 9 - 13 turns, until bolt releases 9. Receive tether hook from EV1 10. Attach hook to HR 3484 (Zenith stanchion) <ol style="list-style-type: none"> 11. Hold for EV1 GO; Bolts 8, 9, 10 released and beam tether installed 12. PGT (B7, 25.5 ft-lb, CCW2 30 RPM) 6-in ext: Release Bolt 12, 9 - 13 turns, until bolt releases <div data-bbox="1312 1242 1850 1408"> <p>CAUTION</p> <ol style="list-style-type: none"> 1. Do not pull tray out more than 3-in from Face 2 2. Do not impart loads into beam without minimum of 2 bolts installed </div>

EVA RPCM Remove/Replace S0-2B_D (02:30)

GROUND IV	EV1 (Gennady)	EV2 (Mike)
<p>Powerdown DDCU LA2A for RPCM R&R √ DDCU LA2A Converter Off Give EV1 & EV2 Go for R&R</p> <p>Note: CETA lights will be turned off due to DDCU power-down</p>	<p><u>OPEN SPDA DOOR</u></p> <p>14. Hold HR on fluid umbilical tray; Give EV2 ready signal 15. Lift fluid umbilical slightly as door slides open NOTE: Tray max lift of 3-in at port end</p> <p>16. Cinch tie down tether 17. Go to Outpost; Get MCC-H Go for RPCM removal (Inhibits complete); Crew Rest 18. On MCC-H GO; Translate back to RPCM worksite</p> <div data-bbox="667 613 1207 711" style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p style="text-align: center; background-color: red; color: black; margin: 0;">WARNING</p> <p style="margin: 0;">Edges of RPCM housing may be sharp, use caution while handling</p> </div> <div data-bbox="667 743 1207 847" style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p style="text-align: center; background-color: yellow; color: black; margin: 0;">CAUTION</p> <p style="margin: 0;">1. Avoid contact to SPDA Radiator (Face 3) to prevent hardware damage</p> </div> <p><u>RPCM R&R</u></p> <p>19. Hand ORU Bag spare RET hook to EV2</p>	<p><u>OPEN SPDA DOOR</u></p> <p>13. On EV1 GO, Slide door stbd to open position NOTE: Do not push door open far enough to engage soft dock</p> <p>14. Go to Outpost; Get MCC-H Go for RPCM removal (Inhibits complete); Crew Rest 15. On MCC-H GO; Translate back to RPCM worksite BRT to 3490</p> <div data-bbox="1312 613 1852 711" style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p style="text-align: center; background-color: red; color: black; margin: 0;">WARNING</p> <p style="margin: 0;">Edges of RPCM housing may be sharp, use caution while handling</p> </div> <div data-bbox="1312 743 1852 1279" style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p style="text-align: center; background-color: yellow; color: black; margin: 0;">CAUTION</p> <ol style="list-style-type: none"> 1. Failure to use wobble socket, or socket with equivalent outer diameter, to release lock springs can result in damage to the RPCM Drive Screw Assembly 2. Do not operate drive screw with scoop attached to microconical. The wobble socket feature will not extend thru the round scoop 3. Failure to align and fully seat socket until lock springs have released can result in damage to RPCM Drive Screw Assembly 4. Combined linear and rotational motion on the socket while inserting, can result in damage to RPCM Drive Screw Assembly </div> <p><u>RPCM R&R</u></p> <p>16. Verify failed RPCM 2B_D S/N 5299 17. Tether to failed RPCM with EV1 tether Note: Hook pointed toward RPCM</p>

EVA RPCM Remove/Replace S0-2B_D (02:30)

GROUND IV	EV1 (Gennady)	EV2 (Mike)
<p>RPCM Drive Screw Install Turns: ____ Torque: ____</p> <p>Powerup DDCU LA2A; RPCM checkout Give EV1 & EV2 Go to secure worksite</p> <p>Note: CETA lights may be turned on after DDCU power-up</p>	<p>20. Receive failed RPCM 21. Stow failed RPCM in ORU Bag 22. Hand replacement RPCM to EV2 (Verify not S/N 5299)</p> <p>23. Receive round scoop 24. Stow in ORU Bag</p> <p>25. Go to Outpost; Give MCC-H GO to Powerup Crew Rest 26. On MCC-H GO; Translate back to RPCM worksite</p> <p><u>CLOSE SPDA DOOR & SECURE UMBILICAL</u> 27. Uncinch strap 28. Hold HR on fluid umbilical tray; Give EV2 ready signal 29. Lift fluid umbilical slightly as door slides closed NOTE: Tray max lift of 3-in at port end 30. Receive round scoop 31. Stow in ORU Bag 32. Align stanchion alignment pin on bolt 10 fitting as EV2 aligns bolt 12; Give EV2 go for bolt drive</p> <p>33. Remove tie down tether from Node 3 Tray HR 34. Stow tie down tether in ORU Bag</p>	<p>18. PGT (A6, 8.3 ft-lb, CCW2 30 RPM) 6-in ext: Release Drive Screw, push while turning, ~ 8 turns to hard stop 19. ✓ Status Indicator - UNLOCK 20. Remove failed RPCM, slide off guide rail (use round scoop from SPDA door if necessary) 21. Hand failed RPCM to EV1 22. Inspect guide rail for debris/damage 23. Receive replacement RPCM from EV1 24. Inspect RPCM connector interface for debris/damage 25. Install RPCM on guide rail and slide into softdock 26. ✓ Status Indicator - not below UNLOCK 27. Tether to RPCM tether point; Hook facing RPCM 28. Remove round scoop; Hand to EV1 29. PGT (A2, 3.8 ft-lb, CW2 30 RPM) 6-in ext: Fasten Drive Screw, push while turning, 6-7 turns to hard stop 30. ✓ Status Indicator - LOCK 31. Report torque and turns to MCC (@ outpost if no comm) 32. Go to Outpost; Give MCC-H GO to Powerup Crew Rest 33. On MCC-H GO; Translate back to RPCM worksite</p> <p><u>CLOSE SPDA DOOR & SECURE UMBILICAL</u> 34. On EV1 GO, Slide door port to close position 35. ✓ Alignment mark, verify door does not slide freely 36. Remove round scoop 37. Hand round scoop to EV1</p> <p>38. On EV1 Go, PGT (A2, 3.8 ft-lb, CW2 30 RPM) 6-in ext: Install Bolt 12, 9 - 12 turns NOTE: Umbilical Secure Options Bolt 12 or Bolt 11 Or Bolt 10 or leave tie down in place 39. Report torque and turns to MCC as available 40. Remove tie down tether hook from HR 3484 41. Hand to EV1</p>

EVA RPCM Remove/Replace S0-2B_D (02:30)

Tools:

EV1	EV2
PGT	PGT
7/16 Socket-9 ext	7/16 (wobble) Socket-6 ext
Round scoop	Round scoop
Russian Tie down tether	

EVA Fasteners:

Fastener Name	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
RPCM Drive Screw	7/16	1	5.5 (grnd) 3.8 (orbit)	4.5	18.6 (remove) 8.5 (install)	8 (remove) 6-7 (install)	30
SPDA Door Bolts	7/16	2	7.08 (grd)	8.3	14.27	13	30
Fluid Umbilical Launch Restraints	7/16	4	3.8	20.8	37.5	9-13 (remove) 9-12 (install)	30
Fluid Umbilical Stanchion Bolts	7/16	2	3.8	27.4	37.5	11.5-13.5 until clamp-up	30

EVA Connectors: None

ORU Identification:

	Serial Number
Spare RPCM	X800390
Failed RPCM	5299

Note:

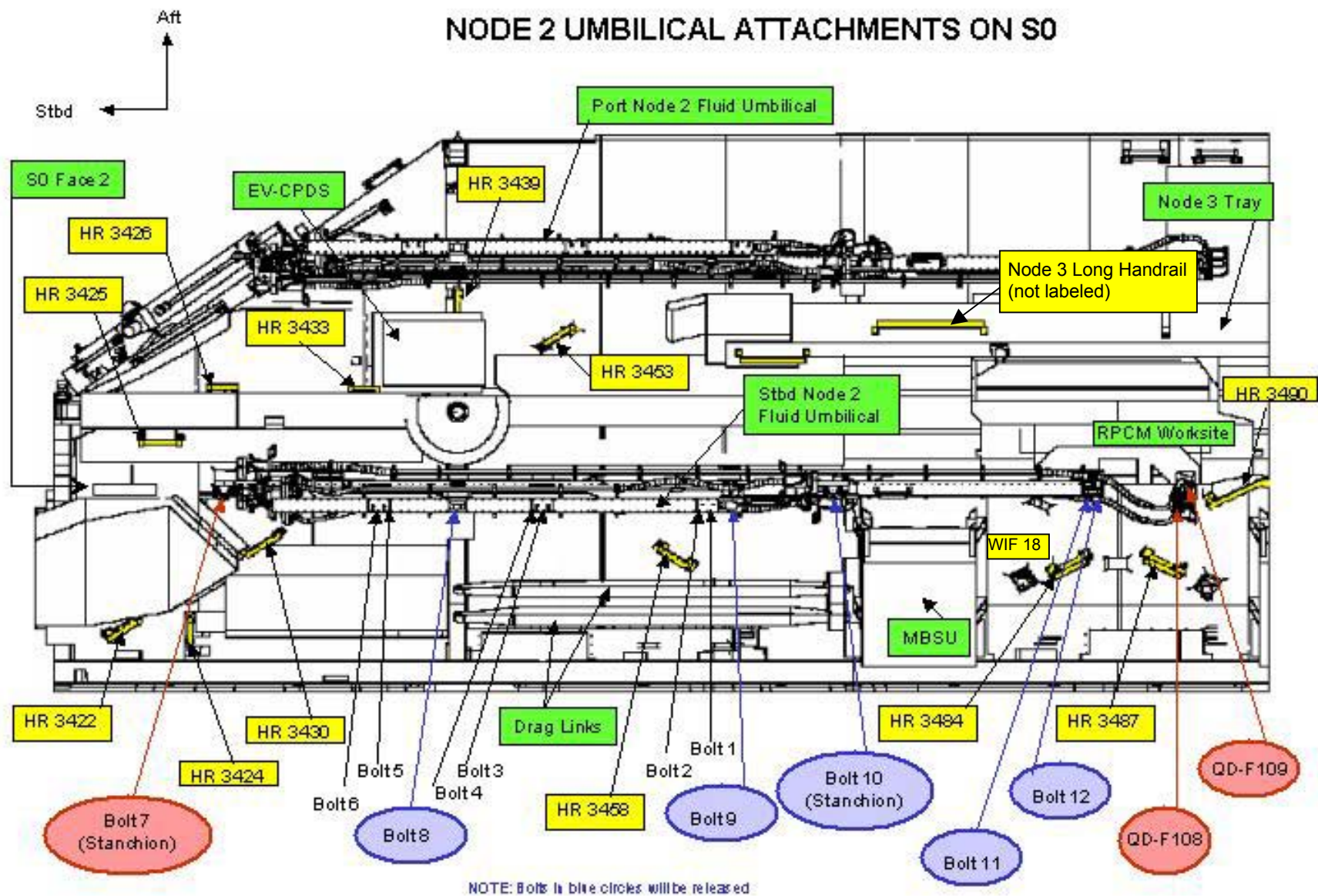
1. The round scoop is removed for bolt driving operations to allow for visual verification of socket engagement on the drive screw
2. Installation of tether on RPCM tether point must be oriented such that the hook is facing the body of the RPCM. Otherwise interference between the SPDA frame and the RPCM will not allow hook removal.

Cautions:

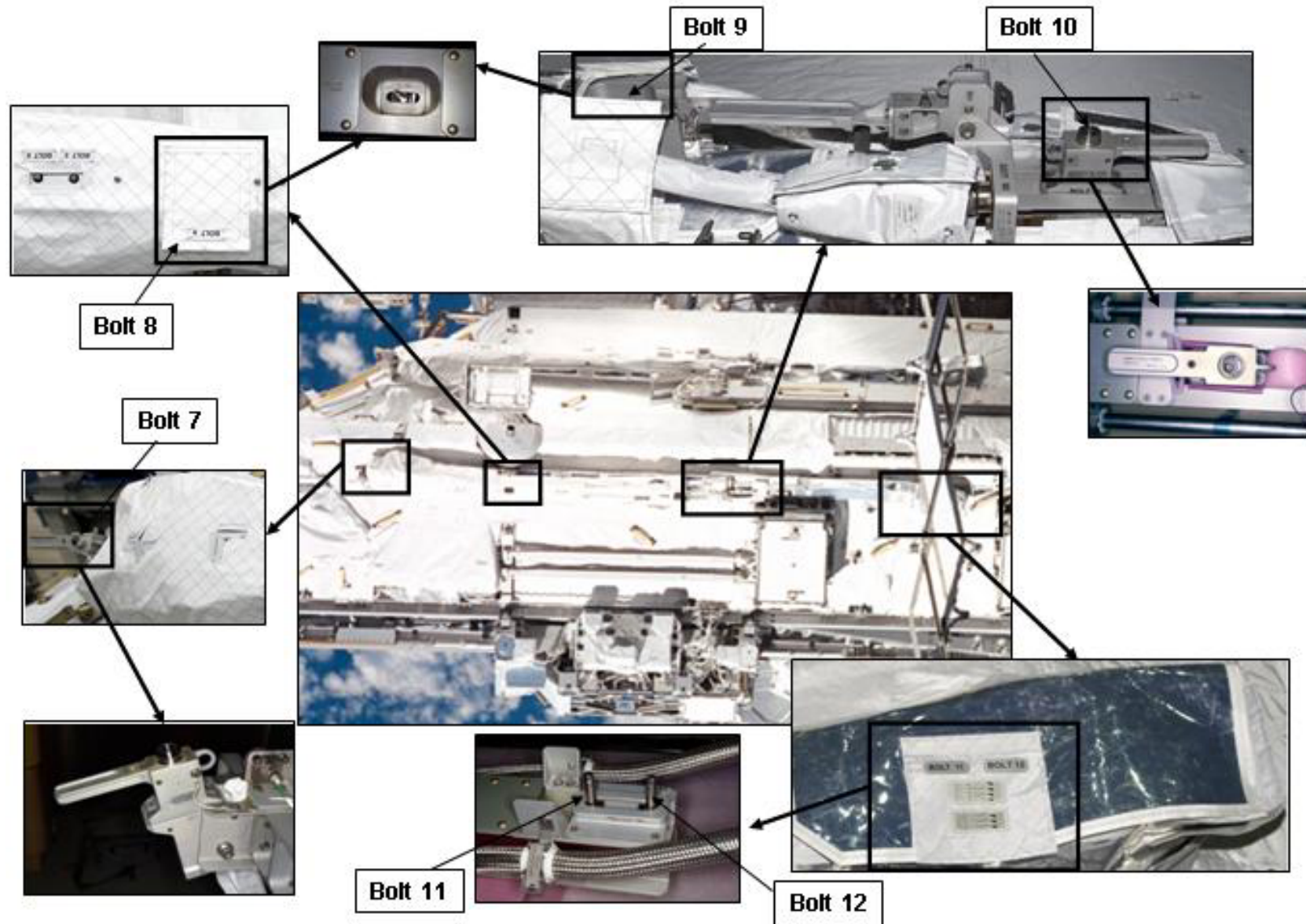
1. Failure to use wobble socket, or socket with equivalent outer diameter, to release lock springs can result in damage to the RPCM Drive Screw Assembly
2. Do not operate drive screw with scoop attached to microconical. The wobble socket feature will not extend thru the round scoop
3. Failure to align and fully seat socket until lock springs have released can result in damage to RPCM Drive Screw Assembly
4. Combined linear and rotational motion on the socket while inserting, can result in damage to RPCM Drive Screw Assembly
5. If worksite is left unattended at any time with just Bolt 7 and the tether tie down, the tether must be cinched snug.

Warnings:

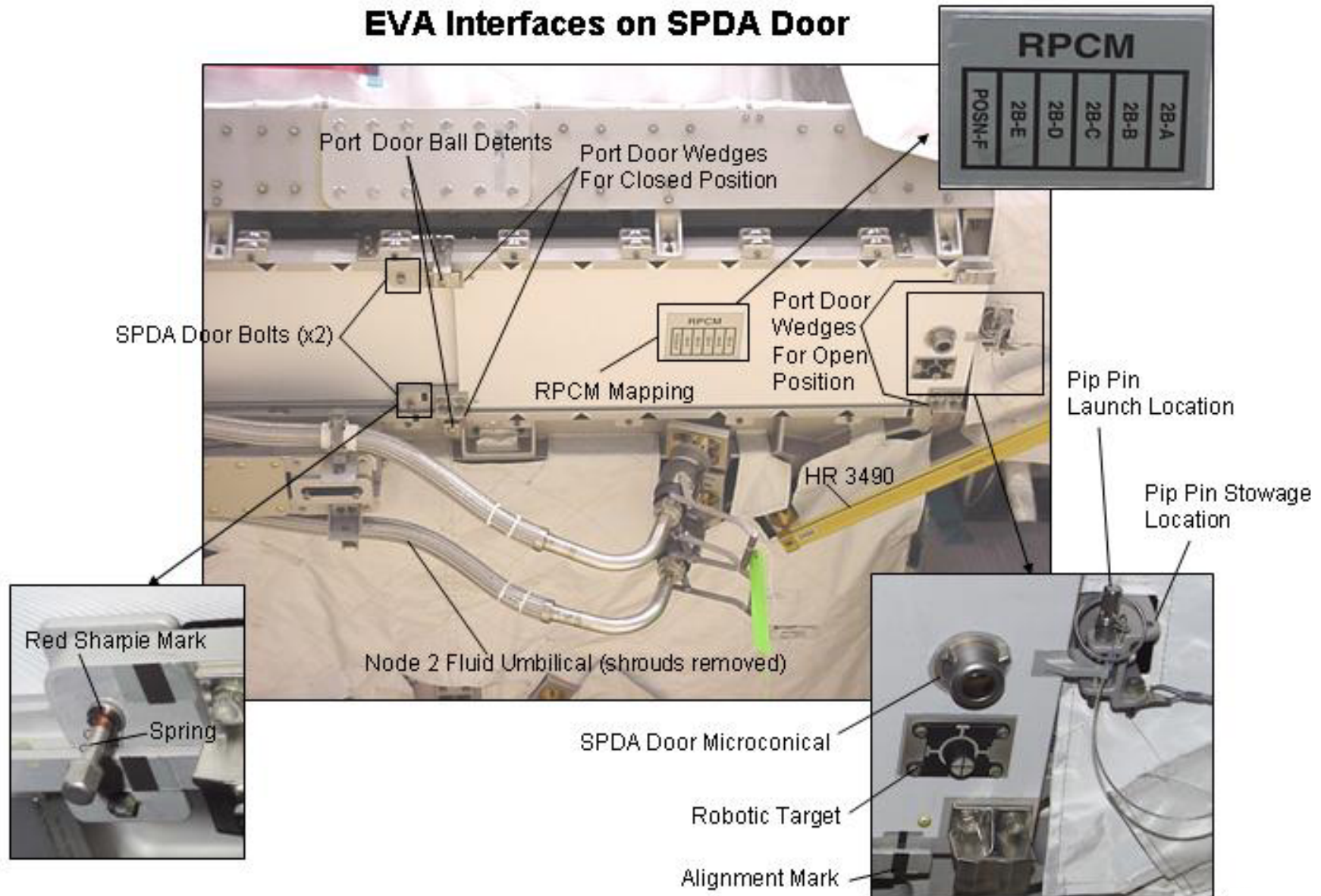
1. RPCM may have sharp edges, use caution while handling



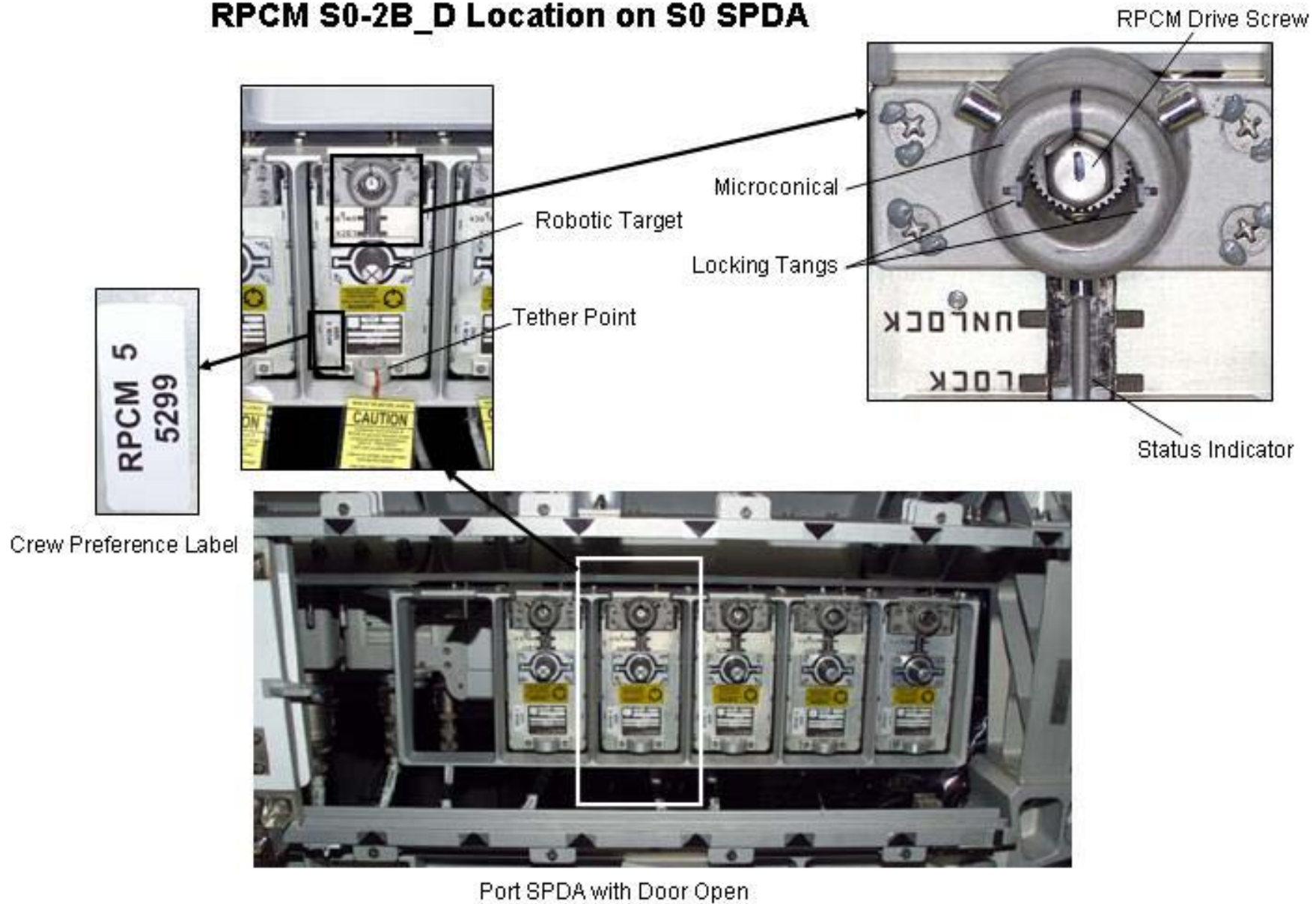
Node 2 Umbilical On-orbit and Detailed Photos



EVA Interfaces on SPDA Door



RPCM S0-2B_D Location on S0 SPDA



US EVA Cleanup (00:45)

GROUND IV	EV1 (Gennady)	EV2 (Mike)
	<ol style="list-style-type: none"> 1. Verify all tools stowed in ORU Bag (tool inventory as time allows) 2. Translate to S0 HR 3412 for tether swap NOTE: EV2 leads on return to deconflict tethers 3. Retrieve PGT from EV2, stow in ORU Bag 4. Stow ORU Bag on KPU <p><u>TETHER SWAP AT S0</u></p> <ol style="list-style-type: none"> 5. Attach Bungee tether to structure 6. Transfer waist tether to tether reel of PMA tether 7. Attach load alleviating strap of PMA tether to D-Ring extender 8. Remove load alleviating strap of S0 tether; stow on KPU 9. Remove S0 safety tether from HR 3410 Stow on KPU 10. Tether and Receive EV2 safety tether, stow on KPU 11. Translate with KPU to PMA1 HR 0003 12. Attach Bungee tether to structure 13. Attach fixed length tether to FGB structure 14. Receive safety tether from EV2, attach to KPU 15. Stow EV2 safety tether on KPU 16. Remove PMA safety tether load alleviating strap from D-Ring, attach to KPU 17. Remove PMA safety tether from PMA HR 0003 18. Stow safety tether on KPU <p><u>Final Config</u> Russian Tether Protocol; Both tethers attached to FGB Tethered to KPU</p>	<ol style="list-style-type: none"> 1. Translate to S0 HR 3411 for tether swap NOTE: EV2 leads on return translation 2. Hand PGT to EV1 <p><u>TETHER SWAP AT S0</u></p> <ol style="list-style-type: none"> 3. Attach Bungee tether to structure 4. Transfer waist tether to tether reel of PMA tether 5. Attach load alleviating strap of PMA tether to D-Ring extender 6. Remove load alleviating strap of S0 tether 7. Hand strap of safety tether to EV1 8. Remove S0 safety tether from HR 3411 9. Translate with KPU to PMA1 HR 0004 10. Attach Bungee tether to structure 11. Attach fixed length tether to FGB structure 12. Remove PMA safety tether load alleviating strap from D-Ring, hand to EV1 13. Remove PMA safety tether from PMA HR 0004 <p><u>Final Config</u> Russian Tether Protocol; Both tethers attached to FGB Tethered to KPU</p>